

# **ATTACHMENT**

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## **Cougar Dam Deep Drawdown Injunction Measure 2021-08-19**

### **Description/Intent**

On July 14, 2021, the U.S. District Court for the District of Oregon issued a draft Interim Injunction Order that, once finalized, will direct the Corps to implement specified operations intended to improve conditions for fish passage and water quality in the Willamette Valley Project (WVP) to avoid irreparable harm to Endangered Species Act (ESA) - listed salmonids during the interim period until the completion of the reinitiated ESA consultation. These measures must be carried out “to the greatest extent practicable under existing hydrologic conditions and necessary flood control operations” while making “every effort to comply with the various water temperature, TDG and instream flow requirements governing WVP.”

The Draft Order requires the Corps to conduct a deep drawdown of Cougar Dam beginning in the fall of 2021. The Court did not define the specific details of this operation but instead assigned an Expert Panel comprised of two of Plaintiffs’ experts, two NMFS biologists, two Corps employees, and two “ad hoc” Federal experts to define the details of this and other measures. The deep drawdown measure, as specified by the Court, must: (1) be performed during peak juvenile migration timing; (2) prioritize volitional fish passage; (3) draw down the reservoir elevation to within 25 ft. or less of the regulating outlets (ROs); (4) prioritize use of the ROs during the drawdown, especially during the hours between sunset and sunrise; and (5) where applicable, not preclude the ability to produce hydropower for the entire duration of the October through March critical power production period.

When developing and planning for the implementation of any operational change, multiple factors must be considered.

- First, what is/are the biological objective(s) or goal(s) being sought and how can these objectives best be achieved?
- Second, what are the constraints or factors that need to be considered?
- And third, what additional information should be considered when shaping the operation?

### **Biological Goal**

The goal of this drawdown measure is to provide improved downstream fish passage and survival for juvenile spring Chinook salmon through Cougar Reservoir and past Cougar Dam. Through past biological study (or Research, Monitoring and Evaluation, RM&E), regional biologists have learned that fish tend to:

- exit Cougar Reservoir at night;
- pass in higher numbers when the reservoir is lower in elevation (and fish can more easily find an outlet through the dam);
- and survive at greater numbers when passed through non-turbine outlets.

The timing and target elevation of the Cougar Reservoir drawdown operation proposed below is designed to draw Cougar Reservoir down to elevation 1505 ft. by November 15, and as early as November 1, if possible without exceeding 800 cfs; and hold at this targeted elevation until December 15. On December 16, the Corps will use the RO during nighttime hours until el 1532 is reached. The Expert Panel will develop a spring passage implementation plan by October 15, 2021, which will provide direction for management of reservoir levels in winter 2022 and may address management in late December.

During drawdown from minimum conservation pool elevation (1532 ft.) to the targeted drawdown elevation of 1505 ft., the ROs will be prioritized to discharge water from the reservoir. The diversion tunnel will not be used during this special operation.

### **Constraints and Considerations**

To meet the targeted elevation by November 1, the Corps needs an operations plan in place now. This plan should consider both the constraints that must not be violated, as well as other considerations such as current hydrologic conditions, etc. While implementing the drawdown of Cougar Dam the following constraints must be adhered to at all times:

- a. Regulating outlet (RO) outflows of greater than 800 cfs are known to produce total dissolved gas (TDG) in exceedance of 110%. This should be avoided unless actively fighting a flood.
- b. Normal drawdown and refill rates must be followed to protect embankments and the dam. This includes no greater than a 3ft/day drawdown or a 5ft/day refill rate.
- c. The RO gates should not be opened less than their minimum gate opening restriction, which is 1.25 ft.
- d. The Corps' flood control mission supersedes all other actions and at no time will human health or safety be jeopardized during the implementation of this measure.
- e. There is a natural "saddle dam" located in Cougar Dam. When the reservoir is drawn down below this feature, at elevation 1485 ft. NGVD29 the main reservoir is cut off from the cul-de-sac where the Cougar outlet structures exist. As such, Cougar Reservoir should not be drawn down below that elevation. This will impact the success of this operation and the ability to volitionally pass fish downstream.

In addition to the constraints, the following considerations were used to develop the Cougar Drawdown implementation plan:

- a. Total project discharge in excess of 700 cfs through October 15 should be avoided.
- b. Operating the ROs at elevations below 1495 ft. has some potential flow control issues (pressurizing and depressurizing the upstream portions). This type of flow condition is known to cause damage and should be avoided.
- c. The Water Temperature Control Tower (WTC) can be operated to a minimum elevation of 1571 ft. Once the reservoir drops below this elevation, water temperature management is no longer possible.

- d. The Cougar Adult Fish Facility is typically operated from mid-March through mid-October. The facility is dependent on turbine flows, so the timing of when flows are transitioned from the turbines to the ROs should be considered.
- e. Larger RO gate openings provide safer passage and are more protective for fish. This should be taken into consideration.
- f. There is some post-wildfire slope repair work above and around the regulating outlet outfall structure that is being planned for the fall. The schedule is to be determined. While this repair work isn't expected to conflict with the drawdown operation, this work should be coordinated accordingly.

## Implementation Plan

Taking the constraints and considerations described above into account, the following implementation plan has been developed for the 2021 Cougar Drawdown Injunction Measure. Note that this drawdown plan is tied to the hydrologic conditions of 2021; next year's plan is likely to look different. In addition, because of the short timeframe to submit this plan, a more developed RM&E plan will be developed by the Expert Panel later this fall or early 2022 that would address the deep drawdown in fall 2022 and beyond. That RM&E plan would also include adaptive management guidelines. What will not change from year to year is the overall goal of the operation and the constraints. For this fall, Cougar project outflows will be managed from August through September to ensure healthy riverine conditions for downstream spawners.<sup>1</sup> Outflow will be increased incrementally in late August to a maximum of 700 cfs by early September in order to reach the target drawdown level as early as possible, and to prevent a large increase in flow (e.g., >800 cfs) that may increase TDG.

Once elevation 1571 ft. is reached<sup>2</sup>, the ROs will be prioritized while balancing adult fish collection and downstream water quality. This outlet prioritization is based on past RM&E that indicates that fish begin exiting the reservoir in greater numbers once Cougar Reservoir is at or below elevation 1571 ft. (Table 1.). And, since it is generally accepted that survival is greater when fish are passed through the ROs (as compared to the turbines) at Cougar Dam, these outlets will be prioritized once elevation 1571 ft. is achieved. During daytime periods, turbines may be used to provide attraction flow for the adult fish facility.

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<sup>1</sup> Proposed flows during drawdown are higher than the maximum spawning season flow set in the BiOp, but a large section of the South Fork McKenzie downstream of the dam has been restored to multiple channels, therefore the ecological conditions for spawning have been improved since the issuance of the BiOp. However, at higher flows redds could be made in areas of the river that may be susceptible to dewatering if flows need to be decreased for purposes of flood control. As discussed in the Biological Monitoring section below, the Corps, or its designee will conduct spawning surveys, in the South Fork McKenzie River downstream from the dam and will collect data on location of redds and depth of water over a subset of redds to provide a baseline for monitoring potential effects of flow decreases during incubation.

<sup>2</sup> Based on current forecasts, Cougar Reservoir is expected to drop below ele. 1571, concluding temperature control, sometime in the third week of September.

**Table 1. Dam passage efficiency estimates, standard errors and lower and upper 95% confidence intervals by reservoir elevation from the study of acoustic-tagged juvenile Chinook salmon at Cougar Dam, Oregon in 2012.**

[Sample size is the number of tagged fish in the denominator of the estimate, SE is standard error, LCI is lower 95% confidence interval, UCI is upper 95% confidence interval]

Study Period	Fish Origin	Elevation (ft)	Sample size	Est	SE	LCI	UCI
Spring	Hatchery	1690 to 1571	422	0.111	0.015	0.085	0.145
Fall	Hatchery	1690 to 1571	284	0.169	0.022	0.130	0.217
		<1571 to 1532	282	0.653	0.028	0.595	0.706
		<1532 to 1516	77	0.260	0.050	0.175	0.367
		<1516 to 1500	34	0.147	0.061	0.065	0.301
	Wild	1690 to 1571	8	0.000	0.000	0.000	0.000
		<1571 to 1532	43	0.651	0.073	0.502	0.776
		<1532 to 1516	7	0.286	0.171	0.082	0.641
		<1516 to 1500	4	0.000	0.000	0.000	0.000

Project outflows will begin to increase in late August and held throughout September and then increased to 800 cfs in mid-October so that the targeted elevation of 1505 ft. can be achieved by November 15, or earlier if possible without exceeding 800 cfs and TDG cap. Based on current forecasts, outflows will increase to 800 cfs starting on October 15; prioritization will be given to the ROs. Adjustments to this plan will be made in real time based on, among other things, current weather, hydrologic conditions, meeting target level early, keeping flow below 800 cfs to avoid excessive TDG, accommodating research downstream of the dam, and accommodating collection of adult salmon in the trap.

Once the reservoir is at, or below, minimum conservation pool (ele. 1532 ft.), and while the reservoir is held at 1505 ft., the ROs will be used exclusively to discharge water and provide fish passage. In the event of floods, poor water quality or emergency power needs<sup>3</sup>, the turbines may need to be utilized. Such conditions will be scheduled and managed in real-time and operational adaptations will be made as necessary to meet fish passage criteria and minimize electric imbalance where possible.

Varying inflows will cause reservoir elevations to fluctuate; and, while these fluctuations will be managed, it will not be possible to hold Cougar Reservoir at a flat elevation of 1505 ft. at all times. Some reservoir elevation fluctuations should be expected. Additionally, outflows from the dam will also fluctuate and should be expected. Efforts will be made to maintain el 1505 +/- 5 ft to minimize rapid changes in discharge, or discharges in excess of 800 cfs during the drawdown period, to the extent practical.

<sup>3</sup> Cougar Dam has the ability to support the city of Blue River in the event of an emergency power need even if the reservoir is drawn down below minimum power pool (ele. 1516 ft.). Corps engineers have confirmed there are no structural concerns with generating below the minimum power pool.

On December 16, Cougar Reservoir will be allowed to refill, following the refill rates identified in the constraints section. After the reservoir reaches ele. 1516 ft., the Corps will use the ROs during nighttime hours until ele. 1532 is reached. The timing of the reservoir refilling above minimum power pool will be dependent on precipitation and is therefore highly variable but is generally expected sometime in January. The Expert Panel will develop a spring passage implementation plan by October 15, 2021, which will provide direction for management of reservoir levels in winter 2022 and may address management in late December.

### **Drawdown Plan Summary**

In summary, the following operational plan is proposed:

1. Hold Cougar project outflows at or below 700 cfs through October 15.
2. Once ele. 1571 ft. is reached, prioritize releases through the ROs while balancing adult fish collection and downstream water quality needs. During daytime periods, some turbines flow may be needed to provide attraction to the adult fish facility.
3. Beginning on October 15, increase project outflows to 800 cfs and hold until the target elevation of 1505 ft. is achieved by November 15, or earlier if possible; prioritize the ROs. Note: additional outflow may be required depending on rain events and inflow conditions. Adaptive management will be applied as necessary.
4. Once the reservoir is at or below minimum conservation pool (ele. 1532 ft.) use the ROs exclusively to discharge water unless an emergency situation arises.
5. Hold Cougar Reservoir at elevation 1505 ft. from November 15 (or earlier if possible) to December 15, as best as possible. Use the ROs exclusively during this time unless an emergency situation arises.
6. Begin refilling Cougar Reservoir on December 16 (RO operations only). After the reservoir reaches ele. 1516 ft., the Corps will use the ROs during nighttime hours until ele. 1532 is reached.
7. Avoid dewatering established redds until fry emergence to the extent possible.<sup>4</sup>

### **Potential Impacts and Mitigation**

RO spill can create high TDG levels downstream of Cougar Dam and should remain below 800 cfs unless necessary for flood control, since RO outflows greater than 800 cfs are known to generate TDG that violates the state water quality standard of 110%.

Risks to cultural resources from illegal looting during the deep drawdown will require both increased law enforcement/patrol efforts, increased signage, and education and outreach. Archaeological surveys/monitoring may also be needed to quantify negative impacts from

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<sup>4</sup> The end date of redd protection will be based on estimated emergence using accumulated degree-days since the median date of active spawning. The minimum flows should be protective of redds based on the United States' current understanding of the system.

erosion and sedimentation (may also require aerial imagery or LiDAR acquisition). Gates, rocks, or other barriers should be erected to restrict off road vehicle use in the exposed lakebed.

Adult bull trout will likely be present in the reservoir during this operation, and some may pass through the ROs while they are in operation. While not certain of the level of impact, USFWS biologist suspect there will be some individual level impacts that otherwise may not have been incurred had those adult fish remained in the reservoir.

### **Biological Monitoring <sup>5</sup>**

The following was developed to address the goal of the Draft Order to “provide meaningful research, monitoring, and evaluation (“RM&E”) of the interim measures.” RM&E for the fall 2021 drawdown was developed on a very short timeline and therefore may not be as robust as in a more developed plan. However, the objective of this RM&E is to learn as much as possible from the fall 2021 downstream fish passage operation to inform not only this year’s operation, but outyear operations as well. In addition, because of the short timeframe to submit this plan, a more detailed RM&E plan will be prepared by the Expert Panel later this fall or early 2022 that would address the deep drawdown in fall 2022 and beyond. That RM&E plan would also include adaptive management guidelines.

The metrics of interest include spring Chinook juvenile passage timing, size at passage, passage rates and passage survival.

The RM&E activities to evaluate the fall 2021 deep drawdown are as follows (additional detail and background information is provided below this section). The Corps will attempt to conduct the RM&E as outlined in this proposal in fall 2021, but there is uncertainty regarding the availability of fish, equipment, personnel and funding<sup>6</sup> necessary to carry out such activities given the short time remaining before the RM&E would need to be implemented.

- A. The Corps, or its designee, will conduct spawning surveys, in the South Fork McKenzie River downstream from the dam and will collect data on location of redds and depth of water over a subset of redds to provide a baseline for monitoring potential effects of flow decreases during incubation.
- B. Operate rotary screw traps below the dam in the RO and turbine channels to capture, measure, and sample fish.
  1. Enumerate juvenile salmon caught in the trap.
  2. Conduct periodic trap efficiency tests for expanding the trap catch to estimate the number of salmon leaving the reservoir. Because trap catch may be low and because fish caught in the trap may be kept for holding mortality studies, juvenile hatchery

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<sup>5</sup> We dissent. Richard Domingue and Kirk Schroeder, the Plaintiffs’ representatives on the Expert Panel support implementation of all aspects of this plan, including the biological monitoring measures. However, we believe the biological monitoring measures are insufficient and submit our dissent at the end of this plan.

<sup>6</sup> RM&E activities that were not already planned to occur in fall 2021 are subject to the Corps being able to reprogram or reallocate sufficient funding to carry out those activities in accordance with applicable fiscal laws and authorities prior to when the RM&E would need to be implemented this fall.



salmon may be used for the tests. Tests should be conducted at different flows. A minimum of two tests should be conducted for each major flow change (e.g. during the shift from 700 cfs to 800 cfs, then when flows return to minimum).

3. Measure (fork length) randomized sample of fish throughout outmigration period to provide length frequency of outmigrants. The purpose of this metric is to provide information about the life history of the juvenile salmon passing the dam.
- C. Collect information on condition and mortality of fish caught in rotary screw traps.
  1. Record condition of captured fish outmigrating from the reservoir including degree of de-scaling, injuries, degree of copepod infestation, etc.
  2. When fish are available, hold juvenile salmon caught in the trap every week to directly assess delayed mortality (aim for 30–50 fish per week); note that this direct measure of delayed mortality supplements assessments through tagging and downstream sampling. Fish for the test could be held at the Cougar adult collection facility and would be monitored and recorded for 24–48 hours.
- D. If available by mid-October, release marked juvenile spring Chinook fish into the reservoir to help assess fish passage efficiency. In future years, PIT tag or active-tag studies will be carried out and developed in coordination with the Expert Panel.
- E. Because survival and outmigration studies will likely require the use of surrogate fish to ensure adequate release numbers for statistical analysis, hatcheries should be directed to collect extra eggs in September 2021 to provide surrogate fish beginning in 2022. The Expert Panel will be developing additional implementation plans for other subbasins that may identify studies requiring surrogate fish. If eggs are not collected this fall, then studies requiring surrogate fish would have to be postponed until 2023 at the earliest.

#### Background and additional information

Conducting trap efficiency tests of the rotary screw trap operated downstream of the dam is important to be able to expand the number of salmon migrating past the trap site. Raw numbers of fish caught in the trap are of limited value without information about how effective the trap is during different flows. McKenzie Hatchery salmon can be used to conduct efficiency tests. At least two tests should be conducted during each major flow change during the drawdown period and during the full drawdown period. Fish should be uniquely marked to identify their recapture in the trap.

The Corps should attempt to collect 30–50 fish in various condition from the trap each week and hold them to determine immediate and short-term delayed mortality. It is important to include fish that appear to be not injured and in good condition as part of the sample because internal injuries may not be apparent, yet may result in mortality. Fish would be held at the adult collection facility at Cougar Dam and would be monitored for 24–48 hours. If facilities are available, salmon that appear to be not injured should be held separately to compare their mortality to those fish with various external injuries.

Water quality monitoring data will be used to provide guidelines for adaptive management through the deep drawdown and into the spring drawdown. Potential impacts to areas



downstream of Cougar Dam include increased water temperature that could alter incubation time of eggs in redds and TDG.

Surrogate fish (hatchery fish that are reared to approximate the size of naturally-reared fish) are an important tool for conducting studies that require large release numbers and controlled releases. In anticipation that surrogate fish will be needed for RM&E of court-ordered measures, eggs will need to be collected in September 2021 to ensure fish would be available in 2022 for studies. Therefore, NMFS and the Corps will coordinate with hatcheries to collect eggs and the Corps will provide funds needed to rear surrogate fish.

**Table 2. Estimates of relative reach-specific survival probabilities of radio-tagged juvenile Chinook salmon passing through the regulating outlet at Cougar Dam, Oregon; November and December 2012.**

[Results are based on the estimated survival of fish released at the temperature control tower (treatment group) divided by the estimated survival of fish released in the tailrace (control group) after adjustment for detection of euthanized fish with live transmitters]

Reach	Estimate	Standard error	95-percent confidence interval	
			lower	upper
----- November Study -----				
Temperature control tower to Leaburg Dam	0.4885	0.0497	0.3910	0.5860
Temperature control tower to Marshall Island <sup>1</sup>	0.4594	0.0543	0.3530	0.5659
Marshall Island to Hops Farm	0.7675	0.0821	0.6066	0.9284
----- December Study -----				
Temperature control tower to McKenzie River	0.6669	0.0496	0.5626	0.6807
McKenzie River to Leaburg Dam	0.9543	0.0934	0.7713	1.1373
Leaburg Dam to Marshall Island	1.1612	0.1898	0.7891	1.5333
Marshall Island to Hops Farm	1.0396	0.2766	0.4975	1.5817
Temperature control tower to Leaburg Dam	0.6364	0.0682	0.5026	0.7701
Temperature control tower to Marshall Island <sup>1</sup>	0.7389	0.1160	0.5115	0.9664

<sup>1</sup> Minimum reach for expression of treatment effects.

### Dam Safety Considerations

During previous deep drawdowns (to elevations deeper than the proposed minimum elevation of 1505 ft. for this operation), a temporary increased rate of settlement occurred. The mechanism for this increased settlement rate is being evaluated currently but deep drawdowns could potentially increase the likelihood of potential failure modes for the dam. Although drawdown to elevation 1505 ft. is not expected to increase dam safety related risk, a monitoring plan will be developed prior to the implementation of this operation. The plan will include details for performing a dam crest survey and collecting and reviewing data from existing instrumentation.

Corps engineers recommend maintaining pressurized flow in the regulating conduit during this operation. With the 12.5 foot full gate opening on the Cougar ROs and an invert elevation of 1478.5 ft, MSL, the ROs should not be operated if the water surface elevation drops below

1499.5 ft, MSL. While there is no intention to operate below 1500 ft, maximum gate openings that should be maintained below 1500 ft are listed in Table 3 below.

**Table 3. Recommended Maximum Gate Openings for Specified Low Reservoir Elevations, in feet**

<b>Reservoir Elevation (ft)</b>	<b>Maximum Gate Opening (ft)</b>
1495	9.8
1494	9.2
1493	8.6
1492	8.0
1491	7.4
1490	6.8
1489	6.2
1488	5.6
1487	5.0
1486	4.4
1485	3.8
1484	3.2
1483	2.6
1482	2.0
1481	1.4

### **Power Impacts**

The goal of this operation is to hold Cougar Reservoir at 1505 ft elevation during winter months while prioritizing the use of the ROs. Since the reservoir will be held below minimum power pool, the turbines will not be used. Therefore, station power will have to be supplied from the grid. In the event that the grid is unavailable, power will be provided by backup generators. Cougar Reservoir will be refilled starting on December 16 and is expected to reach minimum power pool (elevation 1516 ft.) sometime in January when hydropower generation can resume. This action will result in up to a 60-95% reduction in power generation, and an associated loss of power revenue, during the critical winter power production period. Starting the “no power period” earlier, or ending it later, will increase the proportion of generation reduced.

### **Transmission Considerations**

Lane Electric Co-Op’s load at Blue River may be out for an extended period if the section of the Cougar – Holden Creek 115kV line between the Blue River Tap and EWEB’s Holden Creek Substation goes down due to icing, a windstorm, fire, or any other reason. When this has

happened in the past – such as during the wildfires of September 2020 -- the Blue River load has been served by generation at Cougar. If Cougar generation is unavailable, then it may be possible to serve the Blue River load from EWEB's Trailbridge or Carmen Smith plants; however, EWEB's transmission staff say that there are regulatory requirements associated with allowable river fluctuations that may make it difficult for them to do so. If EWEB's generation is unavailable, then the only way to provide power to meet the load at Blue River would be through portable diesel generators. Due to the short period prior to implementation, the opportunities to reinforce the system in this area are limited. Further discussions with EWEB are needed to determine whether an emergency provision to re-prioritize Cougar generation to avoid the human health and safety risks of load shedding at Lane Electric Co-Op during the balance of the operation may be necessary if EWEB cannot provide the needed generation.

With all the transmission facilities in service, there may still be some voltage support issues around Blue River and Holden Creek, especially high voltage issues during light load periods. Typically, Cougar generation helps to provide this voltage support. EWEB's generation may be able to provide some help with this needed voltage control, but EWEB's ability to do so may be limited by regulatory requirements.

In addition, reduction, or elimination of generation at Cougar will result in a corresponding increase in the flow of power on the portions of transmission system that carry electricity from east of the Cascade mountains to major load centers on the west side of the Cascades which would marginally increase the stress on these pathways during high load conditions.

### **Plaintiff experts dissent**

We proposed the following RM&E that were rejected by Federal experts apparently for funding or contractual reasons. We fully support the operational aspects of the implementation plan to achieve the fall drawdown. We also feel more information could be collected to inform future fall drawdowns as well as development of a more comprehensive RM&E plan. We realize that results from the 2021 RM&E activities will not be as robust as would be obtained through studies implemented under a more comprehensive plan. However, we believe that tag-based studies we have proposed and the Corps has rejected as unachievable in the time available, would provide much more useful information than the limited activities proposed in the plan above alone. We support conducting all of the studies in the above plan, but we believe they aren't enough. Our proposed studies are technically feasible. That is, hatchery fish would be available to tag and release, tag detection is available downstream at the Walterville Canal diversion outlet (operated by ODFW in cooperation with Eugene Water and Electric Board), and other methods are possible for sampling juvenile fish downstream such as seines or trap nets. Implementation would require a supply of tags, personnel to tag and release fish, and personnel for downstream sampling.

Although we recognize that the Corps may be under some constraints in regards to funding or contracts, we also feel it is important that such constraints be fully explained and that potential solutions be explored before rejecting important RM&E activities.

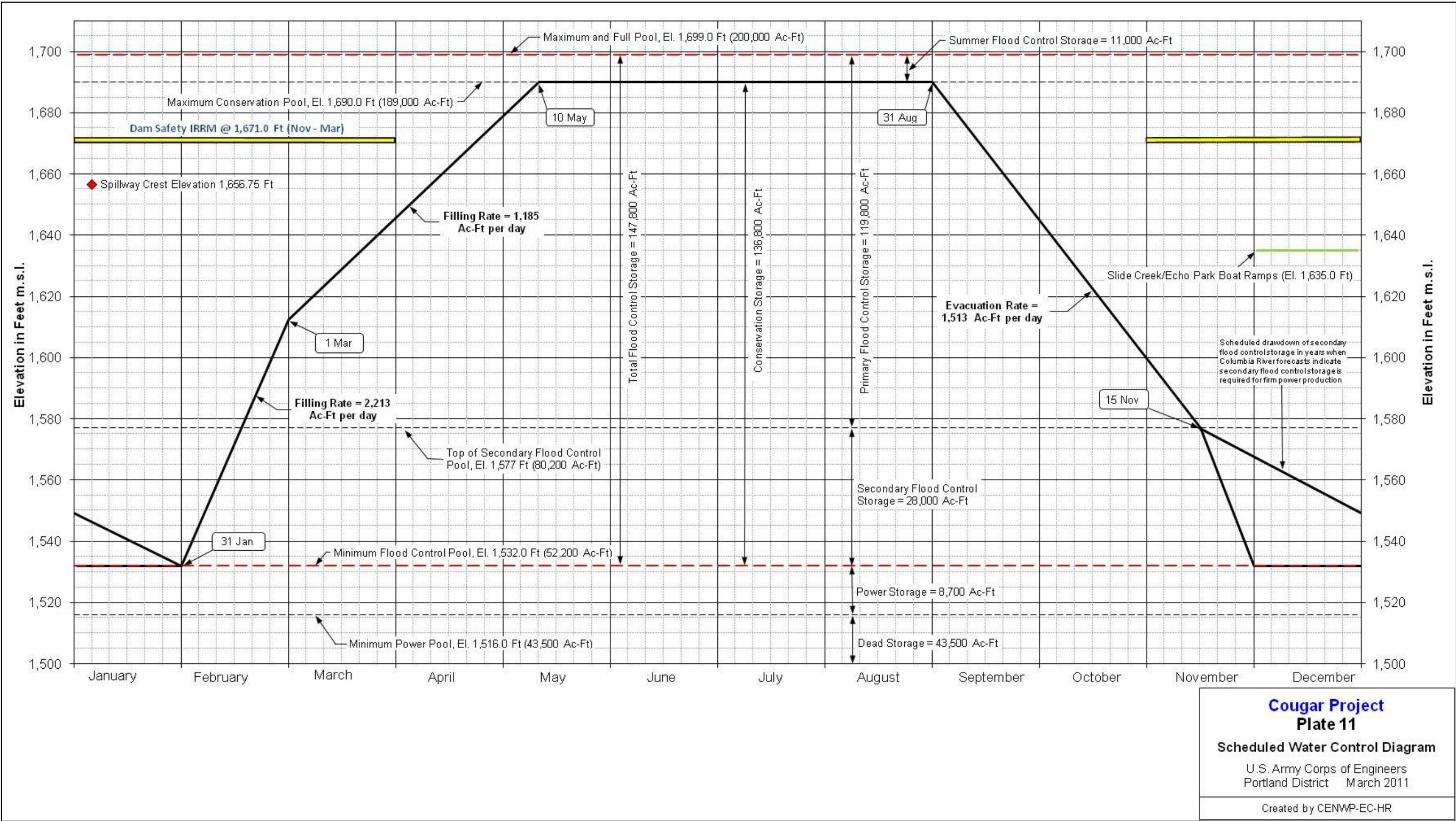
Briefly our RM&E activities were:

1. Release tagged juvenile fish above the reservoir or in the head of the reservoir in late September. Note that ODFW has expressed a willingness to use their tags to expedite this study if they could be reimbursed or get replacement tags. The U.S. experts responded that: "Federal procurement and fiscal laws and regulations prohibit the Corps from reimbursing ODFW for tags or replacing tags. The Corps would need to either perform this work in house or issue a contract in advance of the work occurring, and there is no time to accomplish either in 2021. However, the Federal Government is open to discussing this type of study for potential implementation in future years."
2. Release tagged juvenile fish in the reservoir near the dam with a control group released below the dam in mid to late October prior to reaching full drawdown.
3. Release a second group of tagged fish at the dam and downstream during full drawdown.
4. Monitor passage at all available monitoring sites downstream from the dam to the Walterville canal.

More detail on these activities was included in the draft implementation plan and can be provided to the Court upon request.



Figure 1. Cougar Reservoir Water Control Diagram



## References

Beeman, J.W., Hansel, H.C., Hansen, A.C., Evans, S.D., Haner, P.V., Hatton, T.W., Kofoot, E.E., Sprando, J.M., and Smith, C.D., 2013, Behavior and Dam Passage of Juvenile Chinook Salmon at Cougar Reservoir and Dam, Oregon, March 2012–February 2013: U.S. Geological Survey Open-File Report 2013-xxx, xx p..